

PART 1 – GENERAL

1.1 Related Sections

- .1 Section 03 20 00 Concrete Reinforcing
- .2 Section 03 30 00 Cast-In Place Concrete
- .3 Section 03 35 05 Concrete Finishing

1.2 References

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-O86.1-09, Engineering Design in Wood (Limit States Design).
 - .3 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
- .2 Council of Forest Industries of British Columbia
 - .1 Exterior Plywood for Concrete Formwork.
- .3 ACI
 - .1 ACI 302.1R.96 Guide for Concrete Floor and Slab Construction.

1.4 Delivery, Storage and Handling

- .1 Store materials on site in a manner to prevent damage thereto. Protect from weather. Comply with CSA A23.1, Clause 9.
- .2 Protect work of this Section from damage. Protect other work from damage resulting from this work. Replace damaged work which cannot be satisfactorily repaired.

PART 2 - PRODUCTS

2.1 Materials

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121 and CAN/CSA-O86.1.
 - .2 For concrete with special architectural features, use formwork materials to CAN/CSA-A23.1.
 - .3 Falsework materials: to CSA-S269.1.

- .4 Sealant: to Division 7.
- .5 Waterstops: Extrusions of plasticized PVC low temperature compound to sizes and shapes indicated on drawings.

PART 3 – EXECUTION

3.1 Fabrication and Erection

- .1 Verify lines, levels and bollard centres before proceeding with formwork and ensure dimensions agree with drawings. Verify the locations of all inserts, anchor bolts, cast-ins, etc. with structural, architectural, mechanical, electrical, and shop drawings prior to proceeding with formwork. Report any discrepancies to Departmental Representative immediately.
 - .1 Construct forms to produce plumb and level concrete and true to linear building lines. Maximum variations (not accumulative) as follows:
 - .2 Variation from plumb in concrete surfaces not to exceed 6 mm in 3000 mm nor 10 mm in 6000 mm or more.
 - .3 Variation from level or grade indicated on Drawings for tops of walls not to exceed 6 mm in 3000 mm nor 10 mm in 6000 mm in building length.
 - .4 Variation of concrete slabs and toppings from dead level or slopes as indicated on Drawings not to exceed 3 mm in 3000 mm.
 - .2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
 - .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
 - .4 Fabricate and erect falsework in accordance with CSA S269.1 and Exterior Plywood for Concrete Formwork.
 - .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
 - .6 Do not place shores and mud sills on frozen ground.
 - .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
 - .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions,

locations and levels indicated within tolerances required by CAN/CSA-A23.1.

- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .11 Build in anchors, sleeves, ties, bolts, nailers, templates, shelf angles and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.
- .13 Align forms to ensure no visible defects appear on finished work.
- .14 Take particular care in forming corners and openings. Ensure formwork is tight and braced so no movement occurs.
- .15 Use templates to secure and align anchor bolts in formwork prior to placement of the concrete. Report any interference with reinforcing or other inserts to Departmental Representative prior to the placement of the concrete. Concrete should not be placed until interference issues are resolved in writing by the Departmental Representative.

3.2 Removal and Reshoring

- .1 Leave formwork in place for following minimum periods of time after placing concrete. Proposed removal times to be approved by Departmental Representative in writing prior to work.
 - .1 28 days for beam soffits, slabs, decks and other structural members, or 3 days when replaced immediately with adequate shoring to standard specified for falsework, and when concrete has reached at least 75% of specified 28 day strength.
- .2 Remove formwork when concrete has reached 75 % of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Be responsible for safety of structure, both before and after removal of forms until concrete has reached its specified 28 day compressive strength.
- .4 Take particular care when removing forms to ensure no damage occurs at corners, arises and the like.
- .5 In hot weather, wood forms remaining in place should not be considered adequate for curing but should be removed or loosened so concrete surfaces may be kept moist or coated with curing agent.
- .6 In cold weather, defer removal of formwork or insulate formwork, to avoid thermal shock and consequent cracking of concrete surface.
- .7 Install tie hole plugs immediately following removal of spreader cones. Install to a snug fit, maximum setback from concrete surface as specified.

3.3 Construction Joints

- .1 Form construction joints where required and where indicated. Construction joints shall conform to CSA A23.1, Clause 20.
- .2 Form 38mm x 89mm beveled shear keys full length on construction joints, unless detailed otherwise.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 03 30 00 - Cast-in-Place Concrete.

1.2 References

- .1 American Concrete Institute (ACI)
 - .1 ACI 315R-80, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
- .2 American National Standards Institute/American Concrete Institute (ANSI/ACI)
 - .1 ANSI/ACI 315-80, Details and Detailing of Concrete Reinforcement.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 775/A 775M- O/C, Specification for Epoxy-Coated Reinforcing Steel Bars.
- .4 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-04, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN3-A23.3-04, Design of Concrete Structures for Buildings.
 - .3 CSA G30.3-M1983 (R1991), Cold Drawn Steel Wire for Concrete Reinforcement.
 - .4 CSA G30.5-M1983 (R1991), Welded Steel Wire Fabric for Concrete Reinforcement.
 - .5 CSA G30.14 M1983 (R1991), Deformed Steel Wire for Concrete Reinforcement.
 - .6 CSA G30.15-M1983 (R1991), Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - .7 CAN/CSA-G30.18-M-92 R2002, Billet-Steel Bars for Concrete Reinforcement.
 - .8 CAN/CSA-G40.21-M-92 R2002, Structural Quality Steels.
 - .9 CAN/CSA-G164-M-92 R2002, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .10 CSA W186-M1990, M1998, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 Shop Drawings

- .1 Submit shop drawings including placing of reinforcement.
- .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated. Provide type C tension lap splices unless otherwise indicated.
- .4 Show walls and beams in full elevation and indicate bar size, spacing, laps, bends, etc.
- .5 Show slab reinforcing full length on drawings.
- .6 Detail placement of reinforcing where special conditions occur.

**1.4 Delivery, Storage
& Handling**

- .1 Store materials on site in a manner to prevent damage thereto. Protect from weather. Comply with CSA A23.1, Clause 9.
- .2 Protect work of this Section from damage. Protect other work from damage resulting from this work. Replace damaged work which cannot be satisfactorily repaired.

PART 2 PRODUCTS

2.1 Materials

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .4 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .5 Epoxy coating of non-prestressed reinforcement: to ASTM A 775/A 775M.
- .6 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1. To be adequate for strength and support of reinforcing construction required. Use chairs with plastic coated feet where slab and beam soffits will be exposed.
- .7 Mechanical splices: subject to approval of Departmental Representative.

2.1 Fabrication

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, unless indicated otherwise.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.2 Source Quality Control

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.
- .2 Inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 Field Bending

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

3.2 Placing Reinforcement

- .1 Place reinforcement in accordance with reviewed shop drawings and in accordance with CAN/CSA-A23.1. Support with chairs, bolsters, bar supports or spacers in as close spacing as possible to prevent displacement of reinforcement from intended bar position, before and during placing of concrete. Pieces of block, wood, and/or similar items, are not acceptable as chairs and spacers.

Maximum chair spacing:

10M – 600 mm
15M – 1220 mm
20M – 1625 mm
25M – 1980 mm

- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.

- .3 Prior to placing concrete, obtain Departmental Representative's review of reinforcing material and placement. Provide minimum 24 hours notice prior to concrete placement for review.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Protect epoxy coated portions of bars with covering during transportation and handling.
- .6 Clean reinforcing before placing concrete.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 03 10 00 - Concrete Formwork.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 35 05 - Concrete Finishing.

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 109/C109M-03, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50-mm Cube Specimens).
 - .2 ASTM C 260-01, Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C 309-98a, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C 332-99, Specification for Lightweight Aggregates for Insulating Concrete.
 - .5 ASTM C 494/C494M-99a, Specification for Chemical Admixtures for Concrete.
 - .6 ASTM C 827-1827M-02, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 - .7 ASTM C 939-94a, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
 - .8 ASTM D 412-92, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - .9 ASTM D 624-91, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .10 ASTM D 1751-04, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

- .11 ASTM D 1752-04a, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .3 CGSB 81-GP-1M-10M-79, Flooring, Conductive and Spark Resistant.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A5-93, Portland Cement.
 - .2 CAN/CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.
 - .3 CAN/CSA-A23.2-00, Methods of Test for Concrete.
 - .4 CAN/CSA-A23.5-M86(R1992), Supplementary Cementing Materials.
 - .5 CAN/CSA A363-M88(R1996), Cementitious Hydraulic Slag.

1.3 Samples

- .1 Submit samples in accordance with Division 1.
- .2 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

1.4 Certificates

- .1 Submit certificates in accordance with Division 1.
- .2 Minimum 4 weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Grout.

- .5 Admixtures.
- .6 Aggregates.
- .7 Water.
- .8 Waterstops.
- .9 Waterstop joints.
- .10 Joint filler.
- .11 Bonding agent
- .12 Curing compound
- .13 Column anchor bolts
- .14 Sealant
- .15 Specified admixtures
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .5 Anchor Bolt Setting Diagrams: Submit detailed drawings for anchor bolt setting.
- .6 Records: Keep a written record of concrete pours, showing location, date, cubic yards or metres of concrete including signed trip ticket for each truck, ambient air temperature, and unusual occurrences during placement of each pour. Permit inspection of records by Departmental Representative at any time. At completion of work, submit a summary of such data in 6 copies to Departmental Representative.
- 1.5 Quality Assurance**
 - .1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.

.6 Formwork removal.

.7 Joints.

**1.6 Delivery, Storage
and Handling**

- .1 Store materials on site in a manner to prevent damage thereto. Protect from weather. Comply with CSA A23.1, Clause 9.
- .2 Protect work of this Section from damage. Protect other work from damage resulting from this work. Replace damaged work which cannot be satisfactorily repaired.

1.7 General

- .1 Do not place concrete during or before rain. If rain occurs after placing and before initial set of concrete, cover with waterproof material until set. Embedded materials used in parking structural slab for floor drains, pipes and other hardware shall be non-metallic; and a low copper aluminum alloy, as designated in CAN3-B79 or an equally corrosion resistant metal, coated on surfaces in contact with concrete to prevent galvanic corrosion with steel reinforcing or protected against corrosive effects of de-icing chemicals by an effective and durable coating.
- .2 Do not use calcium chloride or other chemical in mix to reduce freezing point of concrete.
- .3 When ready mixed (mixed in transit) concrete is used, complete discharge of concrete within period of 1 hour after mixing water has been added to dry material except when concrete materials are heated, in which case reduce this period to 30 minutes. When concrete is delivered at air temperature below 4 deg C ensure temperature at work of not less than 16 deg C or more than 32 deg C.

PART 2 - PRODUCTS

2.1 Materials

- .1 Portland cement to CAN/CSA-A5-93 Type 10.
- .2 Blended hydraulic cement: to CAN/CSA-A5A363-88(R1998).
- .3 Supplementary cementing materials: to CAN/CSA-A23.5.
- .4 Cementitious hydraulic slag: to CAN/CSA-A363.
- .5 Water: to CAN/CSA-A23.1.
- .6 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density fine aggregates to CAN/CSA-A23.1.
- .7 Air entraining admixture: to ASTM C 260.
- .8 Chemical admixtures: to ASTM C 494. Departmental Representative to

approve accelerating or set retarding admixtures during cold and hot weather placing.

- .1 Admixtures may be added to concrete to provide following specific qualities as required or permitted in this Section shall meet the following criteria:
 - .1 Workability.
 - .2 Entrained air content.
 - .3 Controlled rate of handling.
 - .4 Compressive or flexural strength.
- .2 Admixtures shall conform to ASTM C260 and ASTM C494M except they shall not, individually or in combination, increase shrinkage of concrete compared with a reference specimen of same mix but not contained admixture. Where used individually, following water reducing admixtures are acceptable.
- .9 Concrete retarders: to ASTM C 494 water based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.
- .10 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C 827. Time of efflux through flow cone (ASTM C 939), under 30s.
 - .2 Flowable: to ASTM C 827. Flow table, 5 drops in 3s, (ASTM C 109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C 827. Flow table, 5 drops in 3 s, (ASTM C 109, applicable portions) 100 to 125 %.
 - .4 Dry pack to manufacturer's requirements.
- .11 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 35 MPa at 28 days.
- .12 Flowable grout: Mixture of one part Portland cement and two parts clean washed sand, with only sufficient water added to allow placing.

- .13 Curing compound: to CAN/CSA-A23.1 and at ASTM C309.
- .14 Ribbed waterstops: extruded PVC of sizes indicated with shop welded corner and intersecting pieces.
- .15 Labyrinth waterstops: extruded PVC of sizes indicated with prewelded corner and intersecting pieces.
- .16 Premoulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D 1751.
 - .2 Sponge rubber: to ASTM D 1752, Type I, flexible grade.
 - .3 Self-expanding standard cork: to ASTM D 1752, Type III.
- .17 Weep hole tubes: plastic.
- .18 Dampproofing below slab on grade:
 - .1 Reinforced: two 10 mil thick polyethylene films bonded each side of asphalt treated creped kraft paper, reinforced with 12 mm x 12 mm fibreglass scrim.
 - .2 Membrane adhesive: as recommended by membrane manufacturer.
 - .3 Lap damp proof membrane minimum 150 mm at joints and seal. Carry up walls to top of slabs.
 - .4 Seal punctures in damp proof membrane before placing concrete. Use patching material at least 150 mm larger than puncture and seal
- .19 Water: Conforming to CSA A23.1, Clause 4.
- .20 Anchor Bolts: To meet specified requirements of ASTM A307, Section 1.3. Provide suitable nuts and washers to meet specified requirements of ASTM A563M, Table 11 (Hot dip galvanized to CSA G164-M).
- .21 Wet Curing: Water conforming to CSA A23.1, Clause 4, clear and entirely free from any elements which might cause staining of concrete, and minimum 4 mil thick polyethylene film as specified herein.

2.2 Mixes

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, to give the following quality for all concrete as indicated.

<u>28 DAY LOCATION</u>	<u>SLUMP* STRENGTH</u>	<u>CLASS OF EXPOSURE</u>
Slab on Grade (Interior)	30MPa	N
Slab on Grade (Exterior)	35MPa	C-1
Foundations Walls	25MPa	F-2
Footings	Refer to Schedules	
Suspended Slabs	Refer to Plans	
Pavement & Walks	32 MPa	C-2
Retaining Walls	35 MPa	C-1

* Obtain these slumps with aid of specified water reducing agent.

* Note: All concrete exposed to exterior conditions to have minimum 6% air entrainment.

- .2 Ready-mixed concrete and concrete proportions shall be in accordance with CSA A23.1, Clause 12 and as follows:

- .1 Minimum allowable compressive strength shall be 25 MPa at 28 Days of age, unless otherwise noted or shown.
- .2 If blended normal Portland cement/cementitious hydraulic slag is used except for floor mixes, slag content shall not be more than 25% of total mass of cement. Total volume of cement in concrete floor mixes shall be 100% Normal Portland Cement.
- .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CAN/CSA-A23.1-M94, Clause 17.5.
- .4 Use of calcium chloride not permitted.
- .5 Do not change concrete mix without prior approval of Departmental Representative. Should change in material source be proposed, new mix design to be approved by Departmental Representative.

PART 3 - EXECUTION

3.1 Preparation

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
 - .1 Obtain Departmental Representative's review of reinforcing placement before placing concrete. Provide 24 hrs. notice prior to placing of concrete. In slab construction, ensure that all bottom steel and at least 66% of top steel is in place and inspected before commencing concrete placement. For walls and columns leave one side of form open for review of reinforcing. Close furing only after Departmental Representative has reviewed bar placement.
- .2 Pumping of concrete is permitted only after approval of equipment and mix in writing by Departmental Representative.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.
- .8 Confirm surfaces on which concrete is to be placed are free of frost, water and debris before placing concrete.

3.2 Construction Joints

- .1 Where construction joints other than those indicated on Drawings are required, locate in consultation with Departmental Representative.
- .2 Unless agreed otherwise for specific locations by Departmental Representative, provide shear keys in all construction joints. Normally, form keys from 38 mm x 89 mm material. Depth of keys shall total approximately 1/4 of the depth of member. In deep members, use 2 or more keys.
- .3 Construction joints shall be straight and plumb unless otherwise agreed for specific conditions.
- .4 Install PVC waterstops in horizontal and vertical construction joints in walls at or below grade, and at other locations where shown. Waterstops shall be continuous throughout length of joint.

- .1 Install waterstops to provide continuous waterseal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing. Tie waterstops in place.
- .2 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections, unless otherwise approved by Departmental Representative.
- .5 Unless otherwise detailed on the Structural Drawings, reinforcement shall be continuous through construction joints.

3.3 Control Joints

- .1 In walls, form grooves for control joints on both faces, as detailed. Unless otherwise noted, cut or stop alternate horizontal reinforcing bars at the joints. Sealant and sealant backing - under Sealant Section in Division 7.
- .2 In slab on grade floors, form or sawcut control joints as detailed.
- .3 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

3.5 Construction

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Sleeves and inserts.
 - .1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative in writing.
 - .2 Where approved by Departmental Representative in writing, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
 - .4 Check locations and sizes of sleeves and openings shown on drawings.
 - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts.
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

- .2 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
- .3 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Formwork. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .7 Finishing.
 - .1 Finish concrete in accordance with CAN/CSA-A23.1
 - .2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
- .8 Installation
 - .1 Preparation for placing concrete:
 - .2 Ensure that foundation excavations are free of frost or water before placing concrete. If a sump is required for pumping water from the excavation, excavate it outside the area of the foundation. Remove any wet or disturbed soil just prior to placing concrete.
 - .3 Before placing concrete, check that all forms are rigid and structurally safe, and that all reinforcing steel, formwork, sleeves, anchor bolts and other items are installed in accordance with the drawings and specifications. Ensure that all trades have checked the security and location of all components required in the concrete by those trades.
 - .4 Ensure that the electrical conduits have been properly set in the mid-height of the slab, beam, or other concrete. Avoid concentrations and crossing of conduit. Any such concentrations which are required shall be approved by the Departmental

Representative before concrete is placed. The Contractor shall coordinate the placing of reinforcement with the Electrical Subcontractor to ensure that both conduit and reinforcement are properly placed.

- .5 Immediately prior to placing concrete slabs on granular base, moisten the base material to reduce absorption of moisture from the concrete.

3.6 Site Tolerance

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1 straight edge method.

3.7 Field Quality Control

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1 and Division 1.
- .2 Concrete cylinder test. Three cylinders from each Day's pour.
- .3 Air entrainment test and slump test made from same batch of concrete from which test cylinders are made.
- .4 Tests will be made in accordance with CSA A23.2.
- .5 Inspection Company's reports of tests will be forwarded to Departmental Representative and Contractor with an opinion or reason for any abnormalities noted thereon.
- .6 Cooperate with and assist Inspection Company's personnel during inspection and tests.
- .7 Remove defective materials and completed work which fails tests and replace as directed by Departmental Representative.
- .8 Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.
- .9 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.
- .10 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

3.8 Depositing

- .1 Notify the Departmental Representative at least 24 hours before each day's operation of placing concrete.
- .2 Convey concrete from the mixer to the place of final deposit by methods which will prevent:

- .1 The separation or loss of ingredients. Chutes, if used, shall be rounded in cross-section and have a minimum diameter of 8 times the maximum aggregate size.
- .2 Do not displace rebar and/or mesh from their specified location.
- .3 Do not deposit any concrete in the work which has partly hardened or which has been contaminated with foreign matter.
- .4 Cast footings, beams and slabs their full design depth in 1 operation. In upstand beams, stepped footings and similar details cast the upper portion as soon as stiffening of the lower portion will permit. The consistency of the lower portion shall be of lower slump than generally specified for the class of work. Remove any free water or laitance from the lower portion before the subsequent layer of concrete is placed.
- .5 Immediately before placing concrete in walls, cover the bottom of the form with a layer of stiff grout. Proportions of cement and sand in the grout shall be similar to that in the concrete being used in the wall.
- .6 Place and consolidate concrete in floors (suspended and on grade) and screed to level ready for finishing under the concrete floor finish section.
- .7 Do not exceed 1.5 m for the free vertical drop of the concrete unless special measures are taken to prevent segregation.
- .8 Where pumps are to be used for placing concrete design the concrete mix accordingly. Maintain design slump at point of entry into pumps and add superplasticizer to take into account the slump lost during the pumping process.
- .9 Unless otherwise agreed by the Departmental Representative, consolidate concrete including slabs on grade in place by means of internal vibrators. Use the largest vibrator consistent with the type and location of concrete being placed. Vibrators shall be in accordance with CSA A23.1, table 14.
- .10 When concrete is being placed in deep members (such as walls and footings) vibrators shall be inserted and withdrawn vertically, and shall not be used to flow concrete into final position. They shall be lowered through the full lift of concrete into the lift below, so as to ensure blending of the concrete in the two lifts.
- .11 Apply vibrators systematically and at such spacing that the zones of influence over-lap. Do not over-vibrate.
- .12 Keep 1 spare vibrator for every three vibrators in use, in case of breakdown.

- .13 After completing concrete in walls or columns, allow at least two hours before placing slabs and beams supported thereon.
- .14 Install continuous waterstops in location shown, fixed rigidly in forms prior to concreting. Waterstop splices to be heat welded in such a manner that the water stopping action will not be impaired.

3.9 Cold Weather Protection

- .1 When the air temperature is below, or is likely to fall below 5 deg C (as forecast by the local meteorological office) carry out all concrete work in accordance with the recommendations of CSA A23.1, Clause 21.2. Have all equipment prepared and operational before commencing to place concrete.
- .2 When heated concrete is exposed to drying effects of wind, provide adequate windbreaks to protect the surface.
- .3 Methods of heating shall be such as to prevent discharge of combustion products over, or drying of, surface of fresh concrete.
- .4 Keep a permanent temperature record conforming to following requirements:
 - .1 Records to show date, time, outside temperature and maximum and minimum temperature at several points within any enclosure, before the placing of concrete in or above enclosure.
 - .2 Use maximum and minimum type thermometers for measuring temperature. If concrete is placed on forms heated from an enclosure below, place thermometers close to the underside of the forms. Temperature record to be kept available for Departmental Representative 's inspection at any time.
 - .3 Temperature of air within enclosures shall not exceed 32 deg C. Maintain concrete temperatures at 21 deg C for 5 days. Removal of concrete protection shall conform to CSA A23.1, clause 21.2.6.
 - .4 Do not place concrete on frozen ground, on ground which contains frozen materials, nor on or against any surface which is at a temperature of less than 10 deg C.

3.10 Hot Weather Protection

- .1 Carry out hot weather concreting, unless otherwise specified, in accordance with CSA A23.1.
- .2 Protect concrete from effect of hot or drying weather conditions. Protect forms and reinforcing from the direct rays of the sun, or cool by fogging and evaporation.
- .3 Refer to curing article for special curing precautions in hot weather.

3.11 Curing

- .1 Protect and cure concrete in such a manner as to prevent evaporation of moisture from the concrete and injury to the surface.
- .2 When the air temperature may exceed 27 deg C curing shall be by methods which keep the surface continually moist for at least 7 days after placing, commencing immediately the concrete has set sufficiently. Moisture shall be applied by fogging or by the application of wetted burlap, or by other acceptable methods which will not damage the surface. A curing membrane is not acceptable under these conditions.
- .3 When the temperature will not exceed 27 deg C a curing membrane specified herein may be used. Membrane curing over slab shall be compatible with finish to be applied. For sidewalks, curbs and similar exterior concrete, use a membrane specified herein.
- .4 Do not use a curing membrane on architectural exposed concrete or where a topping is to be applied.
- .5 For vertical surfaces, forms shall be left in place for a minimum of seven curing days or alternatively forms may be stripped earlier, and the surfaces kept covered with wet burlap, subject to the Departmental Representative's approval. Wood forms remaining in place shall be wetted down during periods of hot weather.
- .6 Except as noted herein above, curing of finished concrete floors and concrete toppings under Concrete Floor Finishes Section.

PATCHING

- .1 Make good temporary openings left in concrete work for pipes, conduit, ducts, shoring and other such work, using mix or mortar of same proportions as surrounding work, reinforced with wire mesh as required, and finish to match surrounding work.
- .2 Have enough expert cement finishers available to complete required patching on same day as forms are stripped.

END OF SECTION

PART 1 - GENERAL

- 1.1 Related Sections** .1 Section 03 30 00 - Cast-in-Place Concrete.
- 1.2 References** .1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 Canadian Standards Association (CSA)
- .1 CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.

PART 2 - PRODUCTS

- 2.1 Chemical Hardeners** .1 Type 1 - Sodium silicate.
- .2 Water: potable.
- 2.2 Sealing Compounds** .1 Surface sealer: to CAN/CGSB-25.20, Type 2 - water based, clear.
- .2 Surface sealers may not be manufactured or formulated with aromatic solvents formaldehyde halogenated solvents mercury lead cadmium hexavalent chromium and their compounds.
- 2.3 Curing Compounds** .1 Select low VOC, water-based, organic-solvent free curing compounds.
- 2.4 Concrete Stains** .1 Select low VOC, water-based concrete stains.
- 2.5 Mixes** .1 Mixing, ratios and application in accordance with manufacturer's instructions.

PART 3 – GENERAL

- 3.1 Finishing** .1 Formed Concrete Surfaces:
- .2 After removal of fins, replace or treat honeycombing or defects in exposed concrete surfaces according to CSA A23.1, para. 24.2, Formed Surfaces. Refer honeycombed areas to the Departmental Representative for designation as structural or non-structural, and repair according to CAN3 Specifications.

- .3 Bring the surfaces of all exposed interior and exterior concrete to a smooth rubbed finish not later than 5-6 hours after removal of forms and in accordance with the requirements of CSA A23.1.
- .4 The producing of smooth surfaces by means of cement plaster will not be permitted unless otherwise specified or scheduled.
- .5 Concrete Floors:
 - .1 Leave slabs reasonably level or sloped to drains, ready for finishing.
 - .2 Refer to Item 4.2 for finishing.
 - .3 Architecturally Exposed Concrete: Sandblast sufficiently to remove laitance, wood grain marks and other blemishes to approval of Departmental Representative.
 - .4 Finish for exposed concrete shall match the approved prototype sample wall and is to have uniform colour and texture throughout.
 - .5 The 'type' numbers are used on the drawings to indicate the locations of different concrete finishes.
 - .6 Concrete not exposed in the finished work e.g. exterior concrete below grade, concealed ceiling spaces and wall surfaces to be finished to CAN/CSA-A23.1-M00.
 - .7 Refer to CSA A23.1, Clause 24 for descriptions of above finishes.

PART 4 - EXECUTION

4.1 Examination

- .1 Verify that all surfaces are ready to receive work and elevations are as indicated on drawings.

4.2 Workmanship

- .1 Steel trowel concrete slabs to be left exposed or to receive resilient flooring or carpeting.
- .2 Other concrete slabs to be screeded off to true lines and levels shown and left ready to receive finish. Depress slabs where required.
- .3 Where floor drains occur, floors to be level around walls and have a minimum 5mm per metre uniform pitch to drains, unless indicated otherwise.
- .4 Co-ordinate with equipment suppliers regarding additional requirements for tolerances on floor level finishes etc.
- .5 Floor Finish (exposed)
 - .1 Finish concrete floors to broom finish and to Clause A23.1 Clause 7.5.1.2.2, and apply floor hardener, non-metallic aggregate at a rate recommended by manufacturer.
 - .2 Apply approved curing/sealing compound to manufacturer's instructions.
 - .3 Sawcut crack-control joints in slabs on grade to CAN/CSA-A23.1-M90 (maximum 18 hours after placement), or as noted on drawings. Seal with joint filler.
 - .4 After curing/sealing and when concrete is dry, seal control joints and joints at junction with vertical surfaces with sealing compound.
 - .5 Clean surfaces and apply second coat curing/sealing compound before handing building over to departmental representative.

4.3 Application

- .1 Curing/Sealing:
 - .1 Liquid Compound Curing/Sealing: Apply compound after saw cutting operations have been completed, at a rate recommended by compound manufacturer. Clean concrete floor of laitance, tire marks, oil, grease, etc. to the satisfaction of the Departmental Representative prior to applying sealing compound.
 - .2 Water Curing: Water cure slabs where so designated. Do not use curing/sealing compound. Water down entire area and cover with polyethylene sheets for a minimum of 7 Days. Sheet coverage to include exposed edges. Provide suitable weights to prevent blow-off or displacement of sheets. Remove cover after minimum 7 consecutive Days. Allow to air dry until concrete has developed design strength.

.2 Sealants:

- .1 Sealant At V-Joints: Prime, prepare substrate and apply sealant full joint depth in accordance with manufacturer's printed directions. Tool to a smooth semi-concave finish. Exclude joints in surfaces to receive waterproofing treatment.
- .2 Sealant at Saw cut Joints/Reglets/Isolation Joints: Do not fill saw cut joints and isolation joints sooner than 30 days after concrete pours. Comply with curing and saw cutting requirements as specified herein. Execute joint sealing as specified herein during cool, dry ambient conditions when slab is in a contracted state to minimize future joint separation at sealant filled joints.

.1 Application:

- .1 Remove temporary polyethylene rope from joints or reglets. Clean joints and blow clean with compressed air.
- .2 Fill sawn joints in concrete slabs full depth with saw cut joint sealant in accordance with manufacturer's printed directions.
- .3 Caulk over isolation joints and reglets with specified sealant per manufacturer's instructions.
- .4 Comply with application and substrate temperature requirements. Mask floor to edge of joints and fill joint with sealant. After initial set, prime sealant surface and refill joints with sealant as required to produce slightly convex joint surface.

END OF SECTION